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(19)

(54) PRODUCTION OF COATINGS

(71) We, PPG INDUSTRIES, INC., a Corporation organized under the laws of the Commonwealth of Pennsylvania, United States of America, of One Gateway Center, Pittsburgh, Commonwealth of Pennsylvania 15222, United States of America, (assignee of BATELLE-INSTITUT e.V.), do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a method for the production of films or coatings on metallic and non-metallic materials, such as glass, ceramics, plastics. More particularly it relates to the production of such films or coatings by depositing and decomposing a substance in vaporized state alone or by means of a carrier gas on the substrate surface. The substrate surface is heated to the decomposition temperature of the substance and the carrier gas may serve as a reactant.

Deposition processes of this kind are known as chemical vapor deposition (CVD). The substrate can provide merely the surface on which the substance is deposited. Generally, however, it is the intention to change the characteristics of the surface by depositing adhering layers.

It is known, for example, to produce pigments and reinforcing materials for elastomers and high-purity metals by means of CVD. This method is also used for growing single crystals, depositing protective films on metallic and non-metallic substrates, preparing semi-conductor materials and producing optical and decorative layers comprising for example, metals, metal oxides or metal nitrides.

When coating materials by means of conventional CVD processes it is very difficult to cover large areas of a material with a uniform layer or to produce layers of graded thickness as desired for some applications. It has proved particularly difficult to provide a continuous strip of material with a layer of uniform or graded thickness.

These disadvantages can, however, be eliminated by means of the present invention in which the vapour or the vapour laden carrier gas is passed through a slit-shaped orifice to the substrate surface, the substrate surface being moved across the orifice.

In a preferred embodiment of the present invention the deposition of the film is controlled by adjusting the relative movement between the slit-shaped orifice and the substrate, the rate and temperature of the carrier gas and the temperature of the substrate surface. It is possible to change these parameters individually or in any desired combination.

By means of the present invention it is possible to produce a uniform film by keeping the relative movement between the slit-shaped orifice and the substrate, the carrier gas rate and temperature and substrate surface temperature constant, or to produce a layer of graded thickness by proper control of these parameters.

In another preferred embodiment of the present invention the film is spread either in uniform or in graded thickness on the surface of a continuous strip.

The present invention will now be further described by way of example with reference to the accompanying drawing.

In the accompanying drawing, the tightly sealed metal envelope (8) consisting, for example of aluminum, is provided with a gas outlet (5) and a slit-shaped orifice (1). The envelope accommodates a hot plate (3), made for example of steel, and a holder for the specimen to be coated (2) which can be moved to and fro at a uniform or non-uniform speed by a geared motor (6) via a transmission (7) and a reversible wormdrive

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(4) so that the substrate surfaces passes over the slit-shaped orifice (1) in the base plate of the metal envelope (8).

In this example, the specimen (2) to be coated is a 150 mm long plane glass plate. The orifice (1) is approximately 3 mm wide and 100 mm long, which corresponds approximately to the width of the glass plate. The glass plate and slit are spaced at an adjustable interval of approximately 4 mm.

To produce a uniform 0.05 µm iron (III)-oxide layer on a glass plate, air heated at 120°C in a furnace is used as the carrier gas. The hot air passing through the iron (III)-acetylacetonate (10) in the vaporizing section (11) is saturated with the iron (III)-acetylacetonate vapour. The carrier gas laden with the vaporized iron(III)-acetylacetonate then passes at a rate of approximately 120 m/min through the slit-shaped orifice into the metal shell (8) and hits the substrate surface, i.e. the glass plate (2) which, at the start of deposition, is heated at approximately 400°C. The glass plate is moved over the orifice at a rate of 12 mm/min. The glass plate is uniformly coated with Fe_2O_3 as a result of the pyrolysis of the iron(III)-acetylacetonate and the carrier gas air on the hot substrate surface.

Instead of the indicated glass plate (2) a continuous strip can be passed through the metal envelope at a specific rate in order to obtain a continuous coating.

WHAT WE CLAIM IS:—

1. A method for the production of coatings on metallic or non-metallic materials which comprises depositing and decomposing a substance in vaporized state alone or by means of a carrier gas on the substrate surface, the substrate surface being heated to decomposition temperature of the substance and the carrier gas possibly serving as reactant, the vapor or the vapour-laden carrier gas being passed to the substrate surface through a slit-shaped orifice and the substrate surface being moved across the orifice.

2. A method as claimed in claim 1 in which the deposition of the film is controlled by variation of the relative movement between the slit-shaped orifice and the substrate, the carrier gas rate and temperature and the substrate surface temperature, these parameters being varied individually or combined.

3. A method as claimed in claim 1 or 2 in which a uniform film is produced by keeping the relative movement between the slit-shaped orifice and the substrate, the carrier gas rate and temperature and the substrate surface temperature constant.

4. A method as claimed in claim 1 or 2 in which a graded layer thickness is established by suitable control of the relative movement between the slit-shaped orifice and substrate, the carrier gas rate and temperature and the substrate surface temperature.

5. A method as claimed in any of claims 1 to 4 in which the film is applied uniformly or in a graded thickness to the surface of a continuous strip.

6. A method as claimed in any of claims 1 to 5 in which the material to be coated is glass, a ceramic or a plastics material.

7. A method for the production of coatings substantially as hereinbefore described with particular reference to and as illustrated in the accompanying drawing.

8. A coating whenever produced by a method as herein described and claimed.

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1 SHEET *This drawing is a reproduction of the Original on a reduced scale*